

Limits and Continuity Questions

1. Traffic flow is defined as the rate at which cars pass through an intersection, measured in cars per minute. The traffic flow at a particular intersection is modeled by the function F defined by

$$F(t) = 82 + 4 \sin\left(\frac{t}{2}\right) \text{ for } 0 \leq t \leq 30,$$

where $F(t)$ is measured in cars per minute and t is measured in minutes.

- (a) Find $F(10)$ and $F(15)$. Indicate units of measure.
- (b) What is the average rate of change of the traffic flow over the time interval $10 \leq t \leq 15$? Indicate units of measure.

2. Let f be the function given by $f(x) = 2xe^{2x}$.

(a) Sketch the graph of f in the viewing window $[-3, 2]$ by $[-1, 8]$

(b) Find $f(-1)$ and $f(0.5)$.

(c) Find $\lim_{x \rightarrow -\infty} f(x)$ and $\lim_{x \rightarrow \infty} f(x)$.

(d) Give any horizontal asymptotes of f .

3. Let f be the function defined by

$$f(x) = \begin{cases} \sqrt{x+1} & \text{for } 0 \leq x \leq 3 \\ 3-x & \text{for } 3 < x \leq 5 \end{cases}$$

(a) Find $f(3)$.

(b) Find $\lim_{x \rightarrow 3^+} f(x)$ and $\lim_{x \rightarrow 3^-} f(x)$.

(c) Explain why f is not continuous at $x = 3$.

(d) Give an expression to use instead of $3 - x$ that would make f a continuous function.

4. Let f be the function defined by $f(x) = 2x - x^2$.

(a) Find $f(3)$ and $f(3+h)$.

(b) Find the value of the difference quotient for f at $x = 3$.

(c) Find the instantaneous rate of change of f at $x = 3$.

(d) Give the equations of the tangent and normal lines to the curve at $x = 3$.